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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
09/452,844	12/03/99	RAAIJMAKERS I	ASMEX.256A

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EXAMINER	
ROCCHEGIANI,R	
ART UNIT	**PAPER NUMBER**
2825	

DATE MAILED: 03/28/01

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

Office Action Summary	Application No.	Applicant(s)	
	09/452,844	RAAIJMAKERS ET AL.	
	Examiner	Art Unit	
	Renzo N. Rocchegiani	2825	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *20 February 2001* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☐ Claim(s) *1-66* is/are pending in the application.

4a) Of the above claim(s) *36-54* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☐ Claim(s) *1-35 and 55-66* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claims _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *03 December 1999* is/are objected to by the Examiner.

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e):

Attachment(s)

15) ☒ Notice of References Cited (PTO-892)
16) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
17) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *4* .
18) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
19) ☐ Notice of Informal Patent Application (PTO-152)
20) ☐ Other:

DETAILED ACTION

Drawings

1. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(4) because reference characters "28a" and "22" in Fig. 1B have both been used to designate the electrode. Correction is required.

2. The drawings are objected to because the specification on page 4 refers to the electrode as "22a" but figure 1B labels the item as "22". Correction is required.

Specification

3. The lengthy specification has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. Claims 1-4, 8, 20-26, 30-32, 35, 55 and 63-66 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent N. 5,650,351 (Wu) in view of U.S. Patent N. 4,058,430 (Suntola et al.).

Wu discloses a process to form a capacitor having a bottom 3-D folding

electrode over a substrate comprising a trench, the electrode defining a volume and being connected via a metal line (Fig. 11). Wherein the bottom electrode is covered by HSG hemispherical grains, with a high dielectric layer formed over the grains (Fig. 11), the dielectric layer comprising one or more films of nitrides and or oxides, including metal oxides (col. 7, lines 15-20) with a total thickness that falls between 20 and 300 Angstroms (col. 7, lines 19-21).

Wu does not disclose layering the dielectric layer by depositing a set a mono-layers using alternating chemistries.

Suntola et al. teaches the formation of a dielectric layer by reacting the surface first with a first reactive species to form a first layer, then reacting the newly formed layer with a second reactive species to form a second layer, and to continue this process to form as many layers as desired with the desired chemistries so as to form a dielectric layer of a preferred thickness (Abstract).

It would have been obvious to one having ordinary skill in the specific art to combine the teachings of Suntola et al. with the invention disclosed by Wu since, Wu discloses a highly dielectric layer and Suntola et al. teach a process to form a dielectric layer that will have a high dielectric constant.

6. Claims 5-7 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent N. 5,650,351 (Wu) in view of U.S. Patent N. 4,058,430 (Suntola et al.) and in further view of U.S. Patent N. 4,747,367 (Posa).

As stated in paragraph 5, all the limitations of these claims have been met except

for teaching the use of a carrier gas and the purging the chamber after the formation of each mono-layer.

Posa teaches the operation of a chamber during the formation of multiple thin layers, wherein a carrier gas is mixed with the reactant gases and wherein each reactant gas is completely purged before the introduction of the next reactant gas (cols. 4 & 5).

It would have been obvious to one having ordinary skill in the specific art to combine the teachings of Posa with the Wu and Suntola et al. since, Posa teaches that by using a carrier gas and purging the chamber of a reactant gas before introducing the next reactant gas will minimize what Posa refers to as "dead space" (col. 3, lines10-15).

7. Claims 9, 11-14, 28, 29, and 56-59 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent N. 5,650,351 (Wu) in view of U.S. Patent N. 4,058,430 (Suntola et al.) and in further view of U.S. Patent N. 6,090,659 (Laibowitz et al.).

As stated in paragraph 5, all the limitations of the claims have been met except for specifying that the reactant gases used to form the mono-layers comprise two metal species such as Ti, Al, Nb, and oxygen so as to form a dielectric layer with a dielectric constant greater than 20.

Laibowitz et al. teaches a method to form a dielectric layer over a semiconductor substrate by depositing mono-layers using reactant gases used to form the mono-layers comprise two metal species such as Ti, Al, Nb, and oxygen so as to form a dielectric layer with a dielectric constant of approximately 50. (col. 2, lines 55-67).

It would have been obvious to one having ordinary skill in the specific art to combine Laibowitz et al. to Suntola et al. and Wu since, Wu teaches the use of tantalum oxide desiring to obtain a high dielectric constant material and Laibowitz et al. teaches other materials that may be used so as to have a very high dielectric constant material layer.

It would also be obvious to one having ordinary skill in the specific art to form a metal nitride and to oxidize the previously layered material since, Wu already discloses forming a nitride also by forming an oxide layer over a previously formed layer inherently involves the oxidation of the previously formed layer.

8. Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent N. 5,650,351 (Wu) in view of U.S. Patent N. 4,058,430 (Suntola et al.) and of U.S. Patent N. 6,090,659 (Laibowitz et al.) and in further view of U.S. Patent N. 6,200,897 (Wang et al.).

As stated in paragraph 7, all the limitations of the claim have been met except for teaching the deposition of a dielectric layer using a metal, silicon and an oxygen containing gas.

Wang et al. teach a CVD of a dielectric material using silicon, a metal and an oxygen containing gas (col. 2, lines 21-26).

It would have been obvious to one having ordinary skill in the specific art to combine the teachings of Wang et al. to the invention disclosed by Wu, since it has been held to be within the general skill of a worker in the art to select a known material

on the basis of its suitability for the intended use as a matter of obvious design choice. *In re Leshin*, 125 USPQ 416.

9. Claims 15 and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent N. 5,650,351 (Wu) in view of U.S. Patent N. 4,058,430 (Suntola et al.) and of U.S. Patent N. 6,090,659 (Laibowitz et al.) and in further view of Ritala et al. ("Zirconium dioxide thin films deposited by ALE using zirconium tetrachloride as precursor" Applied Surface Science, 1993, pp. 333-340).

As stated in paragraph 7, all the limitations of the claims have been met except for teaching the deposition of the dielectric layer using a metal halide with an oxygen containing gas wherein there occurs a ligand exchange reaction with the oxygen containing species.

Ritala et al. teach the mono atomic layer deposition of a metal oxide such as Zirconium Oxide wherein a metal halide such as Zirconium tetrachloride, is reacted is an oxygen containing gas.

It would have been obvious to one having ordinary skill in the specific art to combine Ritala et al. to the Wu since, such a deposition process results in a layer with a more uniform thickness (Ritala et al.). Also, it is inherent that there will be an exchange of ligands since the two gases react with each other

10. Claims 33, 34 and 61 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent N. 5,650,351 (Wu) in view of U.S. Patent N. 4,058,430 (Suntola et al.) and in further view of Ritala et al. ("Zirconium dioxide thin films deposited by ALE using zirconium tetrachloride as precursor" Applied Surface Science, 1993, pp. 333-340).

As stated in paragraph 5, all the limitations of the claims have been met except for teaching the deposition of the dielectric layer using a metal halide with an oxygen containing gas wherein there occurs a ligand exchange reaction with the oxygen containing species.

Ritala et al. teach the mono atomic layer deposition of a metal oxide such as Zirconium Oxide wherein a metal halide such as Zirconium tetrachloride, is reacted is an oxygen containing gas.

It would have been obvious to one having ordinary skill in the specific art to combine Ritala et al. to the Wu since, such a deposition process results in a layer with a more uniform thickness (Ritala et al.). Also, it is inherent that there will be an exchange of ligands since the two gases react with each other.

11. Claim 17 is rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent N. 5,650,351 (Wu) in view of U.S. Patent N. 4,058,430 (Suntola et al.) and of U.S. Patent N. 6,090,659 (Laibowitz et al.) and in further view of Kukli et al. ("Atomic Layer Epitaxy Growth of Tantalum Oxide Thin Films from $Ta(OC_2H_5)_5$ and H_2O" The Electrochemical Society, 1995, pp. 1670-74).

As stated in paragraph 7, all the limitation of the claim have been met except for teaching the deposition of a material that is self-terminated by organic ligands.

Kukli et al. teach the deposition of mono atomic dielectric layer that is self terminated by organic ligands.

It would have been obvious to one having ordinary skill in the specific art to combine Kukli et al. to Wu since, this process will form a smooth surface with uniform thickness (Kukli et al.).

12. Claims 18, 19, 60 and 62 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent N. 5,650,351 (Wu) in view of U.S. Patent N. 4,058,430 (Suntola et al.) and in further view of Kukli et al. ("Atomic Layer Epitaxy Growth of Tantalum Oxide Thin Films from $Ta(OC_2H_5)_5$ and H_2O" The Electrochemical Society, 1995, pp. 1670-74).

As stated in paragraph 5, all the limitation of the claim have been met except for teaching the deposition of a material that is self-terminated by organic ligands, the material comprising tantalum or aluminum, wherein the deposition temperature is less than 350 degree C, and wherein the metal precursor is a metal ethoxide compound.

Kukli et al. teach the deposition of mono atomic dielectric layer that is self terminated by organic ligands wherein the precursor is a metal ethoxide comprising tantalum or aluminum, such ethoxide being reacted with an oxygen containing vapor at a temperature of less than 350 degree C.

It would have been obvious to one having ordinary skill in the specific art to combine Kukli et al. to Wu since, this process will form a smooth surface with uniform thickness (Kukli et al.).

13. Claim 27 is rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent N. 5,650,351 (Wu) in view of U.S. Patent N. 4,058,430 (Suntola et al.) and in

further view of Watanabe et al. ("A New Cylindrical Capacitor Using Hemispherical Grained Si (HSG-Si) for 256Mb DRAMs", IEDM 1992, pp. 259-262).

As stated in paragraph 5, all the limitations of the claim have been met except for teaching the formation of a cylindrical electrode.

Watanabe et al. teaches the formation of an electrode with HSG grains over it, wherein the electrode has a cylindrical shape.

It would have been obvious to one having ordinary skill in the specific art to form a cylindrical capacitor structure since, a capacitor with such a shape will be denser (Watanabe et al.).

Conclusion

14. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Renzo Rocchegiani whose telephone number is (703) 308-5839. The examiner can normally be reached on Monday through Friday from 8:30 am. to 4:30 pm..

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew Smith, can be reached at (703) 308-1323. The fax phone number for the organization where this application or proceeding is assigned is (703) 305-3432.

RNR

March 23, 2001

MATTHEW SMITH
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